Chapter 4. Invertebrate Species of Greatest Conservation Need: Assessments and Conservation Strategies

This chapter provides information on Wisconsin's Invertebrate Species of Greatest Conservation Need including general threats and issues (Section 4.1) and priority conservation actions (Section 4.2) that must be considered in conserving Wisconsin invertebrates, the list of Species of Greatest Conservation Need (Section 4.3), and threats, issues, and priority conservation actions by taxonomic group for the invertebrate Species of Greatest Conservation Need (Section 4.4).

4.1 General Invertebrate Threats and Issues

When considering threats and Priority Conservation Actions that need to be addressed in order to protect and conserve invertebrate species in Wisconsin, the most formidable obstacle to conservation is a lack of knowledge about the basic biology of these species. As is evident from the state of our knowledge tables (Section 2.3.2.2), there are many groups for which we cannot even compile a Wisconsin species list much less describe which species are of conservation need. In addition, the lack of information has fostered extensive public misunderstanding regarding many invertebrate species. Wisconsin is not alone, most invertebrate groups have not been studied or catalogued and basic lists of species are lacking for most taxa for most states (McCollough 1997).

Even for those invertebrates that are relatively well known, a major difficulty researchers and managers face is the lack of readily available, easy-to-use references for the accurate identification of species. This is confounded by the unstable taxonomy in many groups and the lack of investigators working on others. Most taxonomists spend years, even decades, learning the organisms, the literature, and the ecosystems in which the organisms are found. In most cases, this, unfortunately, is not a science that can be performed by amateurs. Incorrect identification leads to confusion, poor interpretation of inventory data, and ultimately, poor decisions regarding resource protection and management.

4.2 General Invertebrate Priority Conservation Actions

- Systematic and focused inventories of invertebrates should be undertaken. Often invertebrates can be collected incidental to other studies/efforts at little additional expense. Data collected should comply with DNR data collection standards and updated protocols.
    - Efforts should be made to link professional observers with non-specialists and leverage opportunities to involve citizen scientists.
- New keys for identifying Wisconsin organisms must be written by experienced taxonomists. These individuals have the background knowledge, literature collections, contacts with other taxonomists, and source materials that are vital to producing high quality reference works.
    - Efforts should be made to compile and make available catalogs of existing taxonomic and related references for Wisconsin invertebrate groups.
    - Experts throughout North America should be contacted prior to initiating work on new keys or taxonomic references to ensure that similar efforts are not underway or that major taxonomic revisions of the taxa under consideration are not forthcoming.
    - Conservation organizations should help foster the training of future taxonomists so understudied invertebrate groups can be investigated more thoroughly (e.g., land managers

could open their properties to inventory efforts, field workers could collect specimens incidental to their work, organizations could fund and publish taxonomic works).

- Consideration should be given to producing interactive computer-based "expert" systems, simultaneously with printed keys/references so that the accuracy of identification by non-specialists can be improved.

- Further define what we need to know to conserve invertebrates (e.g., additional aspects of life history, genetics, etc.) and better determine what we already do know (e.g., consolidate available information on individual or groups of Species of Greatest Conservation Need).

    - Refine methodologies for assessing status and conservation priorities for invertebrate species.

- Additional attention should be focused on groups for which adequate taxonomic references do not exist and for which little zoogeographical or life history information is available.

- Develop management guidelines and best management practices that can be applied to the conservation and management of invertebrate Species of Greatest Conservation Need. Such practices could be applied on both public and private lands.

- Efforts should be made to integrate fully invertebrate Priority Conservation Actions into site planning and land management activities, especially where state or federally listed species are involved. This will require concerted efforts to share data and information with a broader audience.

- Undertake information, education, and media efforts to foster awareness and knowledge regarding the important roles invertebrates play in natural systems and create opportunities for natural resources professionals, citizens, local governments, and other public entities to be involved in invertebrate protection and conservation efforts.

- Develop and implement recovery plans for those invertebrate Species of Greatest Conservation Need that have limited opportunities to remain viable in Wisconsin without meaningful intervention.

4.3 Invertebrate Species of Greatest Conservation Need

Five hundred and thirty invertebrate species have been identified as Species of Greatest Conservation Need in Wisconsin. Species of Greatest Conservation Need are divided into three broad taxonomic groups: Nonarthropod invertebrates (Table 4-1), Noninsect arthropods (Table 4-2), and Insects (Table 4-3).

Table 4-1. Invertebrate Species of Greatest Conservation Need: Nonarthropod Invertebrates

Scientific Name	Common Name	Number of Species in Group
Mollusca: Gastropoda		**Count: 31**
Catinella exile	Pleistocene Catinella	
Catinella gelida	A Land Snail	
Cochlicopa morseana	Appalachian Pillar	
Euchemotrema hubrichti	Carinate Pillsnail	
Gastrocopta procera	Wing Snaggletooth	
Glyphyalinia rhoadsi	Sculpted Glyph	
Glyphyalinia wheatleyi	Bright Glyph	
Guppya sterkii	Brilliant Granule	

Table 4-1 *continued*

Scientific Name	Common Name	Number of Species in Group
Mollusca: Gastropoda, continued		
Hendersonia occulta	Cherrystone Drop	
Hoyia sheldoni	Storm Hydrobe	
Paravitrea multidentata	Dentate Supercoil	
Physella magnalacustris	Great Lakes Physa	
Physella parkeri	A snail	
Planogyra asteriscus	Eastern Flat-whorl	
Striatura ferrea	Black Striate	
Strobilops aeneus	Bronze Pinecone	
Strobilops affinis	Eightfold Pinecone	
Valvata winnebagoensis	Flanged Valvata	
Vertigo bollesiana	Delicate Vertigo	
Vertigo brierensis	Briarton Pleistocene Snail	
Vertigo hubrichti	Midwest Pleistocene Vertigo	
Vertigo hubrichti hubrichti	A Land Snail	
Vertigo hubrichti variabilis	A Land Snail	
Vertigo iowaensis	Iowa Pleistocene Vertigo	
Vertigo morsei	Six-whorl Vertigo	
Vertigo nylanderi	Deep-throated Vertigo	
Vertigo occulta	Occult Vertigo	
Vertigo paradoxa	Mystery Vertigo	
Vitrina angelicae	Transparent Vitrine Snail	
Zonitoides limatulus	Dull Gloss	
Zoogenetes harpa	Boreal Top	
Mollusca: Pelecypoda		**Count: 26**
Alasmidonta viridis	Slippershell Mussel	
Anodonta suborbiculata	Flat Floater	
Arcidens confragosus	Rock Pocketbook	
Cumberlandia monodonta	Spectacle Case	
Cyclonaias tuberculata	Purple Wartyback	
Ellipsaria lineolata	Butterfly	
Elliptio crassidens	Elephant Ear	
Epioblasma triquetra	Snuffbox	
Fusconaia ebena	Ebony Shell	
Lampsilis higginsii	Higgins' Eye	
Lampsilis teres	Yellow & Slough Sandshells	
Lampsilis teres teres	Slough Sandshell	
Leptodea leptodon	Scaleshell	
Plethobasus cyphyus	Bullhead	
Pleurobema rubrum	Pyramid Pigtoe	
Potamilus capax	Fat Pocketbook	
Potamilus ohiensis	Pink Papershell	
Quadrula fragosa	Winged Mapleleaf	
Quadrula metanevra	Monkeyface	
Quadrula nodulata	Wartyback	
Quadrula quadrula	Mapleleaf	
Simpsonaias ambigua	Salamander Mussel	
Tritogonia verrucosa	Buckhorn	
Truncilla donaciformis	Fawnsfoot	
Venustaconcha ellipsiformis	Ellipse	
Villosa iris	Rainbow Shell	
Annelida: Polychaeta		**Count: 1**
Manayunkia speciosa		

Table 4-2. Invertebrate Species of Greatest Conservation Need: Noninsect Arthropods

Scientific Name	Common Name	Number of Species in Group
Crustacea: Anostraca		**Count: 3**
Eubranchipus bundyi	A fairy shrimp	
Eubranchipus ornatus	A fairy shrimp	
Eubranchipus serratus	A fairy shrimp	
Crustacea: Conchostraca		**Count: 1**
Lynceus brachyurus	Holartic Clam Shrimp	
Crustacea: Copepoda		**Count: 4**
Aglaodiaptomus leptomus	A copepod	
Aglaodiaptomus stagnalis	A copepod	
Onychodiaptomus birgei	A copepod	
Limnocalanus macrunus	A copepod	
Crustacea: Isopoda		**Count: 1**
Lirceus lineatus	An aquatic sow bug	
Crustacea: Amphipoda		**Count: 3**
Crangonyx minor	A Side-swimmer	
Crangonyx richmondensis	A Side-swimmer	
Stygobromus putealis	Wisconsin Well Amphipod	
Crustacea: Decapoda		**Count: 4**
Orconectes immunis	Calico Crayfish	
Palaemonetes kadiakensis	Mississippi Grass Shrimp	
Procambarus acutus	White River Crayfish	
Procambarus gracilis	Prairie Crayfish	
Arachnida: Araneae		**Count: 6**
Araneus groenlandicolus	An orb-web spider	
Marpissa grata	A spider	
Paradamoetas fontana	A Jumping Spider	
Phidippus apacheanus	A jumping spider	
Sassacus papenhoei	A spider	
Sphodros niger	A purse-web spider	

Table 4-3. Invertebrate Species of Greatest Conservation Need: Insects

Scientific Name	Common Name	Number of Species in Group
Insecta: Ephemeroptera		**Count: 54**
Acanthametropus pecatonica	Pecatonica River Mayfly	
Ameletus lineatus		
Anepeorus simplex	Wallace's Deepwater Mayfly	
Arthroplea bipunctata		
Baetisca obesa	An Armored Mayfly	
Brachycercus nasutus	A Small Square-gilled Mayfly	
Caenis anceps	A Small Square-gilled Mayfly	
Caenis diminuta	A Small Square-gilled Mayfly	
Caenis hilaris	A Small Square-gilled Mayfly	
Caenis punctata	A Small Square-gilled Mayfly	
Caenis tardata	A Small Square-gilled Mayfly	
Caenis youngi	A Small Square-gilled Mayfly	
Callibaetis pallidus	A Mayfly	
Callibaetis skokianus	A Mayfly	
Centroptilum conturbatum	A Small Minnow Mayfly	
Centroptilum triangulifer	A Small Minnow Mayfly	
Centroptilum victoriae	A Small Minnow Mayfly	
Centroptilum walshi	A Small Minnow Mayfly	
Danella lita	A Spiny Crawler	
Diphetor hageni	A Small Minnow Mayfly	
Dolania americana	American Sand Burrowing	
Drunella cornuta	A Spiny Crawler	
Drunella cornutella	A Spiny Crawler	
Ephemerella catawba	A Spiny Crawler	
Eurylophella aestiva	A Spiny Crawler	
Heptagenia pulla	A Flat-headed Mayfly	
Hexagenia atrocaudata	A Common Burrower Mayfly	
Hexagenia rigida	A Common Burrower Mayfly	
Homoeoneuria ammophila	A Brush-legged Mayfly	
Leucrocuta maculipennis	A Flat-headed Mayfly	
Macdunnoa persimplex	A Flat-headed Mayfly	
Metretopus borealis	A Cleft-footed Minnow Mayfly	
Neoephemera bicolor	A Large Squaregill	
Nixe inconspicua	A Flat-headed Mayfly	
Paracloeodes minutus	A Small Minnow Mayfly	
Parameletus chelifer	A Primitive Minnow Mayfly	
Pentagenia vittigera	A Common Burrower Mayfly	
Plauditus cestus	A Small Minnow Mayfly	
Plauditus cingulatus	A Small Minnow Mayfly	
Procloeon bel lum	A Small Minnow Mayfly	
Procloeon convexum	A Small Minnow Mayfly	
Procloeon irrubrum	A Small Minnow Mayfly	
Procloeon pennulatum	A Small Minnow Mayfly	
Procloeon rubropictum	A Small Minnow Mayfly	
Procloeon rufostrigatum	A Small Minnow Mayfly	
Procloeon simplex	A Small Minnow Mayfly	
Pseudiron centralis	A Flat-headed Mayfly	
Pseudocentroptiloides usa	A Small Minnow Mayfly	
Pseudocloeon dardanum		
Pseudocloeon longipalpus		
Rhithrogena impersonata	A Flat-headed Mayfly	

Table 4-3 *continued*

Scientific Name	Common Name	Number of Species in Group
Insecta: Ephemeroptera, Continued		
Rhithrogena jejuna	A Flat-headed Mayfly	
Rhithrogena undulata	A Flat-headed Mayfly	
Serratella serrata	A Spiny Crawler	
Insecta: Odonata		**Count: 42**
Aeshna clepsydra	Mottled Darner	
Aeshna mutata	Spatterdock Darner	
Aeshna sitchensis	Zigzag Darner	
Aeshna sitchensis	Zigzag Darner	
Aeshna subarctica	Subarctic Darner	
Amphiagrion saucium	Eastern Red Damsel	
Anax longipes	Comet Darner	
Argia plana	Highland Dancer	
Arigomphus submedianus	Jade Clubtail	
Arigomphus villosipes	Unicorn Clubtail	
Coenagrion interrogatum	Subarctic Bluet	
Cordulegaster diastatops	Delta-spotted Spiketail	
Enallagma anna	River Bluet	
Enallagma clausum	Alkali Bluet	
Enallagma traviatum	Slender Bluet	
Enallagma vernale	Gloyd's Bluet	
Epiaeschna heros	Swamp Darner	
Gomphaeschna furcillata	Harlequin Darner	
Gomphus exilis	Lancet Clubtail	
Hetaerina titia	Dark Rubyspot	
Ischnura hastata	Citrine Forktail	
Ischnura kellicotti	Lilypad Forktail	
Ischnura posita	Fragile Forktail	
Libellula cyanea	White-spangled Skimmer	
Libellula incesta	Slaty Skimmer	
Libellula semifasciata	Painted Skimmer	
Libellula vibrans	Great Blue Skimmer	
Macromia pacifica	Gilded River Cruiser	
Macromia taeniolata	Royal River Cruiser	
Nannothemis bella	Elfin Skimmer	
Nehalennia gracilis	Sphagnum Sprite	
Ophiogomphus howei	Pygmy Snaketail	
Ophiogomphus smithi	Sand Snaketail	
Ophiogomphus susbehcha	Saint Croix Snaketail	
Somatochlora cingulata	Lake Emerald	
Somatochlora ensigera	Lemon-faced Emerald	
Somatochlora forcipata	Forcipate Emerald	
Somatochlora hineana	Hine's Emerald	
Somatochlora incurvata	Warpaint Emerald	
Somatochlora tenebrosa	Clamp-tipped Emerald	
Tramea carolina	Violet-masked Glider	
Williamsonia lintneri	Ringed Boghaunter	
Insecta: Plecoptera		**Count: 12**
Allocapnia frisoni	Evansville Snowfly	
Amphinemura linda	Lovely Forestfly	
Attaneuria ruralis	Giant Stone	
Clioperla clio	Clio Stripetail	
Haploperla orpha	Quadrate Sallfly	
Isogenoides olivaceus	Olive Springfly	
Leuctra ferruginea	Eastern Needlefly	

Table 4-3 *continued*

Scientific Name	Common Name	Number of Species in Group
Insecta: Plecoptera, Continued		
Paracapnia opis	Northeastern Snowfly	
Perlinella ephyre	Vernal Stone	
Shipsa rotunda	Intrepid Forestfly	
Soyedina vallicularia	Valley Forestfly	
Zealeuctra narfi	Northern Needlefly	
Insecta: Orthoptera		**Count: 42**
Aeropedellus clavatus	Club-horned Grasshopper	
Arphia conspersa	Speckled Rangeland Grasshopper	
Arphia simplex	A Grasshopper	
Arphia xanthoptera	Yellow-winged Grasshopper	
Booneacris glacialis	Wingless Mountain Grasshopper	
Camnula pellucida	Clear-winged Grasshopper	
Chloealtis abdominalis	Rocky Mountain Sprinkled	
Dendrotettix quercus	Post-oak Grasshopper	
Dichromorpha viridis	Short-winged Grasshopper	
Encoptolophus costalis	Dusky Grasshopper	
Eritettix simplex	Velvet-striped Grasshopper	
Hesperotettix speciosus	A Grasshopper	
Hesperotettix viridis	Green-streak Grasshopper	
Melanoplus benni		
Melanoplus bruneri	Bruner's Spur-throat Grasshopper	
Melanoplus fasciatus	Huckleberry Spur-throat Grasshopper	
Melanoplus foedus	A Spur-throat Grasshopper	
Melanoplus gladstoni	Gladston's Spur-throat	
Melanoplus punctulatus griseus		
Melanoplus rusticus	A Spur-throat Grasshopper	
Melanoplus scudderi	Scudder's Short-winged Grasshopper	
Melanoplus stonei	Stone's Locust	
Mermiria bivittata	Mermiria Grasshopper	
Neoconocephalus lyristes	Bog Conehead	
Neoconocephalus robustus	Crepitating Conehead	
Opeia obscura	Obscure Grasshopper	
Orchelimum delicatum	Delicate Meadow Katydid	
Orphulella pelidna	Spotted-winged Grasshopper	
Paratylotropidia brunneri	An Acridid Grasshopper	
Pardalophora haldemani	Haldmen's Grasshopper	
Phoetaliotes nebrascensis	Large-headed Grasshopper	
Psinidia fenestralis	Sand Locust	
Schistocerca damnifica		
Scudderia fasciata	Black-striped Katydid	
Spharagemon marmorata	Northern Marbled Locust	
Stethophyma gracile	Northern Sedge Locust	
Stethophyma lineatum	Striped Sedge Grasshopper	
Syrbula admirabilis	Handsome Grasshopper	
Trachyrhachys kiowa	Ash-brown Grasshopper	
Trimerotropis huroniana	Lake Huron Locust	
Trimerotropis maritima	Seaside Grasshopper	
Trimerotropis verruculata	Crackling Forest Grasshopper	
Insecta: Heteroptera (Hemiptera, Homoptera)		**Count: 54**
Aflexia rubranura	Red-tailed Prairie Leafhopper	
Amplicephalus kansiensis	A Leafhopper	
Aphelonema simplex		
Attenuipyga vanduzeei	A Leafhopper	
Buenoa limnocastoris	A Backswimmer	

Table 4-3 *continued*

Scientific Name	Common Name	Number of Species in Group
Insecta: Heteroptera, Continued		
Buenoa macrotibialis	A Backswimmer	
Cenocorixa dakotensis	A Water Boatman	
Cenocorixa utahensis	A Water Boatman	
Corisella edulis	A Water Boatman	
Cuerna sayi		
Cymatia americana	A Water Boatman	
Dasycorixa hybrida	A Water Boatman	
Destria crocea	A Leafhopper	
Driotura robusta		
Fitchiella robertsoni		
Flexamia prairiana	A Leafhopper	
Gerris marginatus	A Water Strider	
Hebrus buenoi	A Velvet Waterbug	
Hebrus burmeisteri	A Velvet Water Bug	
Hesperocorixa interrupta	A Water Boatman	
Hesperocorixa laevigata	A Water Boatman	
Hesperocorixa lobata	A Water Boatman	
Hesperocorixa lucida	A Water Boatman	
Hesperocorixa obliqua	A Water Boatman	
Hesperocorixa semilucida	A Water Boatman	
Hydrometra martini	A Water Measurer	
Laevicephalus vannus	A Leafhopper	
Lethocerus griseus	A Giant Water Bug	
Limotettix elegans	A Leafhopper	
Limotettix pseudosphagneticus	A Leafhopper	
Memnonia panzeri		
Microvelia albonotata	A Broad-shouldered Water Strider	
Microvelia fontinalis	A Broad-shouldered Water Strider	
Neogerris hesione	A Water Strider	
Nepa apiculata	A Water Scorpion	
Notonecta borealis	A Backswimmer	
Paraphilaenus parallelus	A Spittle Bug	
Paraphlepsius maculosus	A Leafhopper	
Pelocoris femorata	A Creeping Water Bug	
Polyamia dilata	Net-veined Leafhopper	
Prairiana angustens	A Leafhopper	
Prairiana cinerea	A Leafhopper	
Prairiana kansana	A Leafhopper	
Ramphocorixa acuminata	A Water Boatman	
Ranatra kirkaldyi	A Water Scorpion	
Ranatra nigra	A Water Scorpion	
Sigara dolabra	A Water Boatman	
Sigara macropala	A Water Boatman	
Sigara transfigurata	A Water Boatman	
Sigara variabilis	A Water Boatman	
Trepobates knighti	A Water Strider	
Trepobates pictus	A Water Strider	
Trichocorixa kanza	A Water Boatman	
Insecta: Coleoptera		**Count: 154**
Acilius mediatus	A Predaceous Diving Beetle	
Agabetes acuductus	A Water Scavenger Beetle	
Agabus aeruginosus	A Predaceous Diving Beetle	
Agabus bicolor	A Predaceous Diving Beetle	
Agabus canadensis	A Predaceous Diving Beetle	
Agabus confinis	A Predaceous Diving Beetle	

Table 4-3 *continued*

Scientific Name	Common Name	Number of Species in Group
Insecta: Coleoptera, Continued		
Agabus discolor	A Predaceous Diving Beetle	
Agabus disintegratus	A Predaceous Diving Beetle	
Agabus immaturus	A Predaceous Diving Beetle	
Agabus inscriptus	A Predaceous Diving Beetle	
Agabus leptapsis	A Predaceous Diving Beetle	
Berosus aculeatus	A Water Scavenger Beetle	
Berosus infuscatus	A Water Scavenger Beetle	
Berosus pantherinus	A Water Scavenger Beetle	
Berosus stylifer	A Water Scavenger Beetle	
Celina hubbelli	A Predaceous Diving Beetle	
Cicindela hirticollis hirticollis	A Tiger Beetle	
Cicindela hirticollis rhodensis	Beach-dune Tiger Beetle	
Cicindela lepida	Little White Tiger Beetle	
Cicindela limbalis transversa	A Tiger Beetle	
Cicindela longilabris	A Tiger Beetle	
Cicindela macra	A Tiger Beetle	
Cicindela patruela huberi	A Tiger Beetle	
Cicindela patruela patruela	A Tiger Beetle	
Colaspis suggona		
Collops vicarius	A Melyrid Beetle	
Copelatus chevrolati	A Predaceous Diving Beetle	
Copelatus glyphicus	A Predaceous Diving Beetle	
Crenitis digestus	A Water Scavenger Beetle	
Cymbiodyta acuminata	A Water Scavenger Beetle	
Cymbiodyta blanchardi	A Water Scavenger Beetle	
Cymbiodyta chamberlaini	A Water Scavenger Beetle	
Cymbiodyta semistriata	A Water Scavenger Beetle	
Cymbiodyta toddi	A Water Scavenger Beetle	
Dubiraphia bivittata	A Dubiraphian Riffle Beetle	
Dubiraphia robusta	Robust Dubiraphian Riffle Beetle	
Dytiscus alaskanus	A Predaceous Diving Beetle	
Dytiscus carolinus	A Predaceous Diving Beetle	
Dytiscus dauricus	A Predaceous Diving Beetle	
Ectopria sp. 2	A False Water Penny Beetle	
Enochrus collinus	A Water Scavenger Beetle	
Enochrus consortus	A Water Scavenger Beetle	
Enochrus diffusus	A Water Scavenger Beetle	
Enochrus perplexus	A Water Scavenger Beetle	
Enochrus sayi	A Water Scavenger Beetle	
Graphoderus manitobensis	A Predaceous Diving Beetle	
Gymnocthebius nitidus	A Minute Moss Beetle	
Gyrinus confinis	A Whirlygig Beetle	
Gyrinus gehringi	A Whirlygig Beetle	
Gyrinus impressicollis	A Whirlygig Beetle	
Gyrinus parcus	A Whirlygig Beetle	
Gyrinus pectoralis	A Whirlygig Beetle	
Gyrinus sayi	A Whirlygig Beetle	
Haliplus apostolicus	A Crawling Water Beetle	
Haliplus canadensis	A Crawling Water Beetle	
Haliplus fasciatus	A Crawling Water Beetle	
Haliplus fulvus (=subguttatus)	A Crawling Water Beetle	
Haliplus leopardus	A Crawling Water Beetle	
Haliplus nitens	A Crawling Water Beetle	
Haliplus pantherinus	A Crawling Water Beetle	
Haliplus tortilipenis	A Crawling Water Beetle	

Table 4-3 *continued*

Scientific Name	Common Name	Number of Species in Group
Insecta: Coleoptera, Continued		
Helocombus bifidus	A Water Scavenger Beetle	
Helophorus latipenis	A Water Scavenger Beetle	
Helophorus oblongus	A Water Scavenger Beetle	
Helophorus orchymonti	A Water Scavenger Beetle	
Hydraena angulicollis	A Minute Moss Beetle	
Hydraena pennsylvanica	A Minute Moss Beetle	
Hydrobius melaenum	A Water Scavenger Beetle	
Hydrocanthus iricolor	A Burrowing Water Beetle	
Hydrochara leechi	A Water Scavenger Beetle	
Hydrochara spangleri	A Water Scavenger Beetle	
*Hydrochus brevitars*is	A Water Scavenger Beetle	
Hydrochus currani	A Water Scavenger Beetle	
Hydrochus granulatus	A Water Scavenger Beetle	
Hydrochus rufipes	A Water Scavenger Beetle	
Hydrochus scabratus	A Water Scavenger Beetle	
Hydrochus setosus	A Water Scavenger Beetle	
Hydrochus subcupreus	A Water Scavenger Beetle	
Hydrocolus persimilis	A Predaceous Diving Beetle	
Hydrocolus rubyae	A Predaceous Diving Beetle	
Hydroporus columbianus	A Predaceous Diving Beetle	
Hydroporus dichrous	A Predaceous Diving Beetle	
Hydroporus hybridus	A Predaceous Diving Beetle	
Hydroporus morio	A Predaceous Diving Beetle	
Hydroporus nigellus	A Predaceous Diving Beetle	
Hydroporus obscurus	A Predaceous Diving Beetle	
Hydroporus pseudovilis	A Predaceous Diving Beetle	
Hydroporus pseudovilis	A Predaceous Diving Beetle	
Hydroporus pulcher	A Predaceous Diving Beetle	
Hydroporus stagnalis	A Predaceous Diving Beetle	
Hydroporus tartaricus	A Predaceous Diving Beetle	
Hydroporus vittatus	A Predaceous Diving Beetle	
Hydroporus wickhami	A Predaceous Diving Beetle	
Hygrotus acaroides	A Predaceous Diving Beetle	
Hygrotus compar	A Predaceous Diving Beetle	
Hygrotus falli	A Predaceous Diving Beetle	
Hygrotus farctus	A Predaceous Diving Beetle	
Hygrotus marklini	A Predaceous Diving Beetle	
Hygrotus patruelis	A Predaceous Diving Beetle	
Hygrotus sylvanus	A Predaceous Diving Beetle	
Ilybius angustior	A Predaceous Diving Beetle	
Ilybius gagates	A Predaceous Diving Beetle	
Ilybius ignarus	A Predaceous Diving Beetle	
Ilybius incarinatus	A Predaceous Diving Beetle	
Ilybius picipes	A Predaceous Diving Beetle	
Ilybius pleuriticus	A Predaceous Diving Beetle	
Ilybius subaeneus	A Predaceous Diving Beetle	
Ilybius wasastjernae	A Predaceous Diving Beetle	
Laccobius agilis	A Water Scavenger Beetle	
Laccobius minutoides	A Water Scavenger Beetle	
Laccobius reflexipenis	A Water Scavenger Beetle	
Laccobius truncatipennis	A Water Scavenger Beetle	
Laccophilus undatus	A Predaceous Diving Beetle	
Laccornis deltoides	A Predaceous Diving Beetle	
Laccornis latens	A Predaceous Diving Beetle	
Liodessus cantralli	Cantrall's Bog Beetle	

Table 4-3 *continued*

Scientific Name	Common Name	Number of Species in Group
Insecta: Coleoptera, Continued		
Liodessus flavicollis	A Predaceous Diving Beetle	
Lioporeus triangularis	A Predaceous Diving Beetle	
Lutrochus laticeps		
Matus bicarinatus	A Predaceous Diving Beetle	
Matus ovatus	A Predaceous Diving Beetle	
Megacephala virginica	Virginia Big-headed Tiger Beetle	
Microcylloepus pusillus	An Elmid Beetle	
Nebrioporus rotundatus	A Predaceous Diving Beetle	
Neoporus superioris	A Predaceous Diving Beetle	
Neoporus tennetum	A Predaceous Diving Beetle	
Neoscutopterus angustus	A Predaceous Diving Beetle	
Neoscutopterus hornii	A Predaceous Diving Beetle	
Nicrophorus americanus	American Burying Beetle	
Ochthebius lineatus	A Minute Moss Beetle	
Oreodytes scitulus	A Predaceous Diving Beetle	
Platambus confusus	A Predaceous Diving Beetle	
Postelichus lithophilus	A Long-toed Riffle Beetle	
Rhantus gutticollis	A Predaceous Diving Beetle	
Rhantus sericans	A Predaceous Diving Beetle	
Rhantus sinuatus	A Predaceous Diving Beetle	
Saxinis omogera		
Sperchopsis tessellatus	A Water Scavenger Beetle	
Stenelmis antennalis	A Riffle Beetle	
Stenelmis bicarinata	A Riffle Beetle	
Stenelmis cheryl	A Riffle Beetle	
Stenelmis douglasensis	Douglas Stenelmis Riffle Beetle	
Stenelmis fuscata	A Riffle Beetle	
Stenelmis knobeli	Knobel's Riffle Beetle	
Stenelmis mera	A Riffle Beetle	
Stenelmis musgravei	A Riffle Beetle	
Stenelmis quadrimaculata	A Riffle Beetle	
Stenelmis sandersoni	A Riffle Beetle	
Stenelmis sexlineata	A Riffle Beetle	
Suphisellus puncticollis		
Thermonectes basilaris	A Predaceous Diving Beetle	
Thermonectes ornaticollis	A Predaceous Diving Beetle	
Tropisternus ellipticus	A Water Scavenger Beetle	
Insecta: Trichoptera		**Count: 37**
Agapetus hessi	A Saddle Casemaker Caddisfly	
Agarodes distinctus		
Banksiola dossuaria	A Giant Casemaker Caddisfly	
Beothukus complicatus	A Giant Casemaker Caddisfly	
Brachycentrus incanus	A Humpless Casemaker Caddisfly	
Brachycentrus lateralis	A Humpless Casemaker Caddisfly	
Fabria inornata	A Giant Casemaker Caddisfly	
Hagenella canadensis	A Giant Casemaker Caddisfly	
Hydropsyche arinale	A Netspinning Caddisfly	
Hydropsyche bidens	A Netspinning Caddisfly	
Hydropsyche cuanis	A Netspinning Caddisfly	
Hydropsyche leonardi	A Netspinning Caddisfly	
Hydropsyche phalerata	A Netspinning Caddisfly	
Hydroptila valhalla	A Micro Caddisfly	
Hydroptila virgata	A Micro Caddisfly	
Lepidostoma costale	A Lepidostomatid Caddisfly	
Lepidostoma griseum	A Lepidostomatid Caddisfly	

Table 4-3 *continued*

Scientific Name	Common Name	Number of Species in Group
Insecta: Trichoptera, Continued		
Lepidostoma libum	A Lepidostomatid Caddisfly	
Lepidostoma prominens	A Lepidostomatid Caddisfly	
Lepidostoma vernale	A Lepidostomatid Caddisfly	
Limnephilus janus	A Northern Casemaker Caddisfly	
Limnephilus parvulus	A Northern Casemaker Caddisfly	
Limnephilus perpusillus	A Northern Casemaker Caddisfly	
Limnephilus rossi	A Northern Casemaker Caddisfly	
Limnephilus sericeus	A Northern Casemaker Caddisfly	
Ochrotrichia riesi	A Purse Casemaker Caddisfly	
Oecetis nocturna	A Long-horned Casemaker Caddisfly	
Oxyethira anabola	A Micro Caddisfly	
Oxyethira serrata	A Milk-bottle micro caddisfly	
Polycentropus glacialis	A Trumpet-net Caddisfly	
Polycentropus weedi	A Trumpet-net Caddisfly	
Psilotreta indecisa	A Strong Casemaker Caddisfly	
Rhyacophila lobifera	A Free-linving Caddisfly	
Rhyacophila vibox	A Free-linving Caddisfly	
Triaenodes nox	A Long-horned Casemaker Caddisfly	
Wormaldia moesta	A Fingernet Caddisfly	
Wormaldia shawnee	A Fingernet Caddisfly	
Insecta: Lepidoptera		**Count: 46**
Boloria chariclea	Arctic Fritillary	
Boloria freija	Freija Fritillary	
Boloria frigga	Frigga Fritillary	
Boloria frigga saga	Frigga Fritillary	
Calephelis muticum	Swamp Metalmark	
Callophrys irus	Frosted Elfin	
Catocala coelebs	Old Maid Underwing Moth	
Catocala semirelicta	Semirelict Underwing Moth	
Catocala whitneyi	Whitney's Underwing Moth	
Copablepharon longipenne	A Noctuid Moth	
Erebia discoidalis	Red-disked Alpine	
Erynnis baptisiae	Wild Indigo Dusky Wing	
Erynnis lucilius	Columbine Dusky Wing	
Erynnis martialis	Mottled Dusky Wing	
Erynnis persius	Persius Dusky Wing	
Erynnis persius persius	Persius Dusky Wing	
Euchlaena milnei	A Looper Moth	
Exyra fax	Pitcher Plant Moth	
Faronta rubripennis	Pink-streak	
Grammia oithona	Pithona Tiger Moth	
Hemaris gracilis	Graceful Clearwing	
Hemileuca sp. 3	Midwestern Fen Buckmoth	
Hesperia metea	Cobweb Skipper	
Hesperia ottoe	Ottoe Skipper	
Lacinipolia implicata		
Lycaeides idas	Northern Blue	
Lycaeides melissa samuelis	Karner Blue	
Lycaena dione	Gray Copper	
Macrochilo bivittata	An Owlet Moth	
Oarisma powesheik	Powesheik Skipperling	
Oeneis chryxus	Chryxus Arctic	
Papaipema beeriana	Liatris Borer Moth	
Papaipema silphii	Silphium Borer Moth	
Pieris virginiensis	West Virginia White	

Table 4-3 *continued*

Scientific Name	Common Name	Number of Species in Group
Insecta: Lepidoptera, Continued		
Plebeius saepiolus	Greenish Blue	
Pompeius verna	Little Glassy Wing	
Problema byssus	Byssus Skipper	
Psectraglaea carnosa	Pink Sallow	
Ptichodis bistrigata	A Noctuid Moth	
Pygarctia spraguei	Sprague's Pygarctica	
Richia sp. 1	A Noctuid Moth	
Satyrium caryaevorum	Hickory Hairstreak	
Satyrodes eurydice fumosa	Smokey Eyed Brown	
Schinia bina	Bina Flower Moth	
Schinia indiana	Phlox Moth	
Speyeria idalia	Regal Fritillary	
Insecta: Diptera		**Count: 9**
Blepharicera sp. A	Net-winged Midge	
Blepharicera tenuipes	Net-winged Midge	
Lasiodiamesa sp. or spp.	A Midge	
Parochlus kiefferi	A Midge	
Phalacrocera replicata	A Crane Fly	
Phalacrocera tipulina	A Crane Fly	
Protanypus sp. or spp.	A Midge	
Pseudodiamesa pertinax ?	A Midge	
Ulomorpha sp.	A Crane Fly	

4.4 Threats, Issues, and Priority Conservation Actions by Taxonomic Group

In this section, threats, issues, and priority conservation actions specific to species or species groups are highlighted. These listings of threats and priority conservation actions, however, should be considered illustrative rather than definitive and should be recognized as being specific to the species considered of greatest conservation need, not the entire group to which they belong. Conservation planning for vertebrates can be done at the habitat, landscape, and ecoregional scales. Planning at these scales, however, lacks relevance to most invertebrates, which often have specific microhabitat requirements that can not be addressed adequately at these broader scales. Consequently, readers will not find invertebrates discussed in the habitat sections of this *Strategy.* In addition, the threats and priority conservation actions included in this section focus more on the species and less on their habitats.

Mollusca: Gastropoda (Snails)

The following threats, issues, and conservation actions apply only to terrestrial snails as only land snails are included on the list of Species of Greatest Conservation Need. Aquatic gastropod species are considered as either category 2 or category 4 (see chapter 6 for additional information on these categories).

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.

Habitat Alteration or Loss

Land snails occupy a variety of habitats, but usually prefer sites with shelter, moisture, food, and an available source of lime. Forested river valleys and sites with limestone outcrops

support the most diverse snail assemblages. Several land snail species are closely associated with algific (cold-producing) slopes in the Driftless Area of western Wisconsin. Others occupy similar sites along the Niagara Escarpment in eastern Wisconsin. These habitats are threatened by a variety of factors, including:

- overgrazing and erosion of fragile slopes caused by pasturing animals,
- building of access roads to hilltop agricultural fields or forest management sites,
- quarrying,
- contamination of karst features from surface water runoff,
- recreation trails when placed adjacent cliff bases (trampling can cause compaction of the litter layer where snails live, as well as crushing the animals themselves), and
- development along the bluff tops or in the valleys and removal of vegetation on the slopes.

Invasive Animal Species

- Introduced nonnative gastropods may compete with native gastropods for habitat or may prey upon native species.

Priority Conservation Actions

- Conduct population monitoring and basic life history research.
- Preserve habitat and protect from human disturbance those unique sites currently occupied by snails.
- Maintain natural forest cover to protect surface areas that drain into fissures and minimize opportunities for pesticide infiltration and physical blockage of sinkholes.
- Maintain corridors connecting occupied sites to prevent isolating populations.

Mollusca: Pelecypoda (Mussels)

Threats and Issues

Lack of Information

- Larval hosts and host relationships is incomplete.
- Water quality impacts have not been adequately studied on adult and larval stages.
- Species specific habitat requirements are poorly known.
- Specific causes of large scale (continental) declines are only partially understood.

Alteration of Ecological Processes

Changes in land use patterns have altered the natural hydrologic regimes of some river systems. These changes cause:

- unstable physical habitat alterations (e.g., fluctuating river current velocities, shear stress, altered temperature and water chemistry regimes) that long-lived mussels are unable to adapt to, and
- changes in fish host communities and fish host abundance,

Dams create unnatural conditions that few riverine mussel species are able to tolerate by:

- slowing or stopping the flow of water that mussels need to bring food to them and carry their wastes away,
- restricting fish movements and migrations, thus limiting access to hosts during a critical stage in the mussels' life cycles,
- causing changes in water temperatures and dissolved oxygen concentrations in impoundments and tail waters,

- causing fluctuating water levels that can leave mussels stranded above the water surface,
- creating hydrologic instability (e.g., currents that move or cover mussel beds and sweep mussels onto shifting sandbars where they are smothered), and
- causing increased sediment containment behind the dam which buries mussel beds.

Siltation, primarily from nonpoint source pollution, poses one of the most significant threats to the continued health of Wisconsin mussel populations.

- Heavy sedimentation can bury once suitable habitats along with glochidia (larvae) and resident adult mussels.
- Increased turbidity can result in reduced food supplies and lower oxygen supplies.
- Sediments transport other pollutants of concern (e.g., chemicals and toxins, excess nutrients) that can affect mussel health and longevity.

Water Pollution

Many mussels are highly sensitive to changes in water quality.

- Changes in water hardness, alkalinity, pH, temperature, and dissolved oxygen concentrations can impact mussel populations negatively.
- Many mussels are sensitive to chemical pollutants (e.g. heavy metals, agricultural pesticides, etc.).

Invasive Animal Species

The nonnative zebra mussel and Asiatic clam pose a significant threat to native mussel populations.

- Nonnative zebra mussels colonize the shells of native mussels.
- Zebra mussels compete with native mussels for food resources and may limit reproduction. Asiatic clam may also pose similar threats to native species.

Over-harvesting

Impacts of mussel harvesting include:

- reduction of breeding stock to levels exceeding their maximum sustainable harvest rate (e.g., where reproduction does not offset mortality),
- wasteful death of individuals—especially juveniles—below useful or legal size limits,
- abortion of glochidia by gravid females when disturbed,
- death of adults that are unable to rebury themselves after being uprooted, and
- disruption and destruction of stream and river beds.

Loss of Vertebrate (primarily fish) Hosts

- Loss of larval host species appears to have eliminated some mussel species from some river systems.
- Use of alternative host species may only be marginally successful.

Priority Conservation Actions

- Continue or expand legal protection and monitor harvest.
- Conduct population monitoring and basic life history research.
- Evaluate impacts of changes in water quality and hydrologic dynamics to mussel populations.

- Restore natural hydrologic regimes by removing dams, modifying dam operations, preventing and mitigating nonpoint source pollution, and addressing watershed land use practices.
- Control and manage invasive species; prevent future introductions of nonnative species.
- Consider larval host fish species in fish community management efforts.
- Develop and implement species recovery plans for listed mussel species.
- Apply site specific management for highly localized populations.
- Augment populations or establish species at additional sites (e.g., historic sites).
- Develop and apply general habitat management guidelines.

Many threatened mussel species continue to produce large numbers of viable glochidia (larvae). Therefore, it is logical to suspect that the availability of host species and the survival of the early juvenile stages may be critical issues for the continued survival of some species. Several freshwater mussels considered Species of Greatest Conservation Need have known or suspected vertebrate hosts that are also considered Species of Greatest Conservation Need (Table 4-4). Addressing the conservation needs of these larval host species will be an important part of any conservation strategies for the mussels of conservation need. Actions taken to preserve larval hosts may aid conservation of some mussel populations.

Table 4-4. Mussel Species of Greatest Conservation Need known or suspected to use vertebrate Species of Greatest Conservation Need as hosts

Mussel Species of Greatest Conservation Need	**Larval Hosts (Species of Greatest Conservation Need in *Italics*)**
Arcidens confragosus (Rock Pocketbook)	*American eel*, drum, shad, rockbass, crappie
Cumberlandia monodonta (Spectacle Case)	*mudpuppy* (potentially)
Elliptio crassidens (Elephant-Ear)	*skipjack herring*
Fusconaia ebena (Ebonyshell)	crappie, bass, *skipjack herring*
Lampsilis teres (Yellow Sandshell)	gars, centrarchids, basses, *sturgeon*
Simpsonaias ambigua (Salamander Mussel)	*mudpuppy*

Annelida: Polychaeta (Aquatic Annelid Worms)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.

Water Pollution

Annelids may be sensitive to changes in water quality.

- Changes in water hardness, alkalinity, pH, temperature, and dissolved oxygen concentrations can impact worm populations negatively.
- Many annelids are sensitive to chemical pollutants (e.g. heavy metals, agricultural pesticides, etc.).
- Siltation - primarily from nonpoint source pollution - can bury once suitable habitats and organisms, increase turbidity and lower oxygen supplies, and transport other pollutants of concern that can affect worm populations.

Priority Conservation Actions

- Prepare a synthesis of basic biological information on the single freshwater species included in this group.
- Conduct status surveys, population monitoring, and basic life history research.
- Develop and implement general habitat management guidelines.
- Prevent and mitigate nonpoint source pollution.

Crustacea: Anostraca (Fairy Shrimp)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.

Habitat Alteration or Loss

- Complete loss of natural habitat due to disturbance, draining, and filling of ephemeral ponds. Factors affecting water quality in ephemeral habitats have not been investigated well enough to know their impacts on fairy shrimp populations.

Priority Conservation Actions

- Conduct status surveys, population monitoring, and basic life history research.
- Develop and implement general habitat management guidelines (i.e. for ephemeral ponds).
- Apply site specific management for highly localized populations.
- Protect ephemeral pond habitats.

Crustacea: Laevicaudata (Clam Shrimp)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.

Habitat Alteration or Loss

- Complete loss of natural habitat due to disturbance, draining, and filling of ephemeral ponds and wetlands.

Water Pollution

Clam shrimp may be sensitive to changes in water quality.

- Changes in water hardness, alkalinity, pH, temperature, and dissolved oxygen concentrations can impact crustacean populations negatively.
- Many crustaceans are sensitive to chemical pollutants (e.g. heavy metals, agricultural pesticides, etc.).
- Siltation - primarily from nonpoint source pollution - can bury once suitable habitats and organisms, increase turbidity and lower oxygen supplies, and transport other pollutants of concern that can affect clam shrimp populations.

Invasive Animal Species

- Nonnative cladoceran predators may impact clam shrimp populations.
- Nonnative zebra mussels may alter trophic dynamics in clam shrimp habitats.

Priority Conservation Actions

- Conduct status surveys, population monitoring, and basic life history research.
- Develop and implement general habitat management guidelines (e.g., for ephemeral ponds).
- Apply site specific management for highly localized populations.
- Protect ephemeral ponds and other occupied habitats.
- Control and manage invasive species.
- Prevent and mitigate nonpoint source pollution.

Crustacea: Copepoda (Copepods)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.

Water Pollution

The copepods considered Species of Greatest Conservation Need occupy two primary habitats: pristine marshes and kettles in southern Wisconsin and deep cold high-oxygen water usually in northern Wisconsin. Copepods may be sensitive to changes in water quality.

- Changes in water hardness, alkalinity, pH, temperature, and dissolved oxygen concentrations can impact crustacean populations negatively.
- Many crustaceans are sensitive to chemical pollutants (e.g. heavy metals, agricultural pesticides, etc.).
- Siltation - primarily from nonpoint source pollution - can bury once suitable habitats and organisms, increase turbidity and lower oxygen supplies, and transport other pollutants of concern (i.e. nutrients) that can affect copepod populations.

Invasive Animal Species

- Nonnative cladoceran predators may impact copepod populations.
- Nonnative zebra mussels may alter trophic dynamics in copepod habitats.

Priority Conservation Actions

- Conduct status surveys, population monitoring, and basic life history research.
- Control and manage invasive species.
- Prevent and mitigate nonpoint source pollution.

Crustacea: Isopoda (Isopods, Sow Bugs)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.

Water Pollution

Isopods occupy a variety of aquatic habitats, which are influenced or threatened by a variety of factors. Isopods may be sensitive to changes in water quality:

- Changes in water hardness, alkalinity, pH, temperature, and dissolved oxygen concentrations can impact crustacean populations negatively.
- Many crustaceans are sensitive to chemical pollutants (e.g. heavy metals, agricultural pesticides, etc.).
- Siltation - primarily from nonpoint source pollution - can bury once suitable habitats and organisms, increase turbidity and lower oxygen supplies, and transport other pollutants of concern that can affect isopod populations.

Invasive Animal Species

- Nonnative zebra mussels and crayfishes may alter trophic dynamics in isopod habitats.

Priority Conservation Actions

- Conduct status surveys, population monitoring, and basic life history research.
- Control and manage invasive species.
- Prevent and mitigate nonpoint source pollution.

Crustacea: Amphipoda (Amphipods)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.

Habitat Loss or Alteration

Amphipods occupy a variety of aquatic habitats. These habitats are influenced or threatened by a variety of factors (see also Water Pollution section below).

- The lone locality record in the world presently known to harbor one subterranean species has been covered by a highway, with a manhole located over the site.
- Withdrawing water (surface water, groundwater) can alter the natural groundwater regime that provides the only known habitat for one subterranean species.

Water Pollution

Amphipods may be sensitive to changes in water quality.

- Changes in surface or groundwater hardness, alkalinity, pH, temperature, and dissolved oxygen concentrations can impact crustacean populations negatively.
- Many crustaceans are sensitive to chemical pollutants (e.g. heavy metals, agricultural pesticides, etc.).
- Siltation - primarily from nonpoint source pollution - can bury once suitable habitats and organisms, increase turbidity and lower oxygen supplies, and transport other pollutants of concern that can affect surface water amphipod populations.

Invasive Animal Species

- Nonnative zebra mussels and crayfishes may alter trophic dynamics in amphipod surface water habitats.

Priority Conservation Actions

- Conduct status surveys, population monitoring, and basic life history research.
- Control and manage invasive species.
- Prevent and mitigate nonpoint source pollution.
- Protect and maintain natural groundwater regimes and quality.

Crustacea: Decapoda (Crayfishes and Shrimp)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.
- The effects of bait harvest on crayfish populations remains unknown.

Habitat Alteration or Loss

Crayfishes and shrimp occupy a variety of aquatic habitats. These habitats are influenced or threatened by a variety of factors, including:

- inorganic and organic sedimentation imbedded in stream substrate,
- alteration of flow regimes caused by impoundments and large scale conversion of natural cover types in the watershed,
- point and nonpoint sources of pollutants,
- shoreline modification,
- drainage or impoundment of natural wetlands, and
- introduction of fish or management for fish in naturally fishless (shallow) waterbodies.

Invasive Animal Species

- Nonnative rusty crayfish may compete for resources with native crayfishes.
- Nonnative rusty crayfish may hybridize with native crayfish altering genetic structure of populations.
- Nonnative zebra mussels may alter trophic dynamics in some crayfish habitats.
- Nonnative zebra mussels may colonize the exoskeleton of crayfish and limit the ability to feed and their ability to molt.

Priority Conservation Actions

- Conduct status surveys, population monitoring, and basic life history research.
- Develop and implement general habitat management guidelines (e.g., for ephemeral ponds).
- Apply site specific management for highly localized populations of species of conservation need.
- Control and manage invasive species.
- Prevent and mitigate nonpoint source pollution.

Arachnida: Araneae (Spiders)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.
- Public perceptions of many arachnids remain negative.

Habitat Alteration or Loss

- Complete loss of natural habitat due to conversion of habitat to urban, housing, commercial, industrial, and agricultural development.

Priority Conservation Actions

- Conduct status surveys, population monitoring, and basic life history research.
- Undertake public information and education efforts to foster awareness and knowledge regarding the important roles spiders play in natural systems.
- Develop and apply general habitat management guidelines.

Insecta: Ephemeroptera (Mayflies)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.

Habitat Alteration or Loss

Mayflies occupy a variety of aquatic habitats in their larval stages. These habitats are influenced or threatened by a variety of factors, including:

- alteration of flow regimes caused by impoundments and large scale conversion of natural cover types in the watershed,
- point and nonpoint sources of pollutants,
- shoreline and littoral zone modifications,
- potential global climate change impacts,
- drainage or impoundment of natural wetlands, and
- introduction of fish or management for fish in naturally fishless (shallow) waterbodies.

Priority Conservation Actions

- Conduct status surveys, population monitoring, and basic life history research.
- Develop and apply general habitat management guidelines.

Insecta: Odonata (Dragonflies)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.

Habitat Alteration or Loss

Dragonflies and damselflies occupy a variety of aquatic habitats, but the Species of Greatest Conservation Need tend to be either associated with flowing water, specialized wetlands such as peatlands, and specialized lake types. Species of Greatest Conservation Need often have a life cycle of two to three years which means the predominant life stage (larvae) have to have their requirements met for long periods of time. These habitats are influenced or threatened by a variety of factors, including:

- portion of the watershed in forest cover (stream species),
- inorganic and organic sedimentation imbedded in stream substrate,
- alteration of flow regimes caused by impoundments and large scale conversion of natural cover types in the watershed,
- point and nonpoint sources of pollutants,
- shoreline and littoral zone modifications,
- potential global climate change impacts,
- drainage or impoundment of natural wetlands, and
- introduction of fish or management for fish in naturally fishless (shallow) waterbodies.

Priority Conservation Actions

- Conduct status surveys, population monitoring, and basic life history research.
- Develop and apply general habitat management guidelines.
- Protect and manage specific waterbodies and watersheds containing significant populations of Species of Greatest Conservation Need.

Insecta: Orthoptera (Grasshoppers*)*

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.
- Public perceptions of grasshoppers as agricultural pests may create management obstacles.

Habitat Alteration or Loss

Few grasshoppers are specific in their choices of food plants. The taxa, however, fall into preference groups by vegetation type; grasses, herbs, shrubs and trees. Most open habitat grasshoppers require a loose substrate for oviposition and those that rely on visual signals for mate selection need areas with reduced vegetation. Arboreal species need persistent stands of woody vegetation and some species in this category are found only in proximity to particular families or genera of shrubs or trees. Given these requirements, habitat loss is always a threat to the ability of these animals to persist on the landscape. Threats include:

- complete loss or fragmentation of habitat due to development,
- disturbance due to human activities (recreation, transportation, land management, etc.),
- alteration of plant community structure through succession, prairie management, and incursion of invasive plant species,
- shoreline and wetland modification, and
- non-specific broadcast of insecticides.

Priority Conservation Actions

- Conduct status surveys, population monitoring, and basic life history research.
- Develop and apply general habitat management guidelines.
- Protect dune and similar habitats known to be occupied by Species of Greatest Conservation Need.
- Maintain corridors connecting occupied sites to prevent isolating populations.

Insecta: Hemiptera: Heteroptera (True Bugs)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.

Habitat Alteration or Loss

True bugs occupy a variety of aquatic habitats. These habitats are influenced or threatened by a variety of factors, including:

- alteration of flow regimes caused by impoundments and large scale conversion of natural cover types in the watershed,
- point and nonpoint sources of pollutants,
- shoreline and littoral zone modifications,
- potential global climate change impacts,
- drainage or impoundment of natural wetlands, and
- introduction of fish or management for fish in naturally fishless (shallow) waterbodies.

Priority Conservation Actions

- Conduct systematic species atlasing, status surveys, population monitoring, and basic life history research.
- Protect and manage specific waterbodies and watersheds containing significant populations of Species of Greatest Conservation Need.

Insecta: Hemiptera: Auchenorrhyncha (Plant Bugs, Leafhoppers)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.
- Lack of basic understanding of limiting factors for most species

Habitat Alteration or Loss

- Succession of grassland to woody vegetation
- Plantings or conversions from open vegetation types to plantations, agriculture, etc.
- Narrow host specificity of several species

Priority Conservation Actions

- Conduct systematic species atlasing, status surveys, population monitoring, and basic life history research.
- Develop and apply general habitat management guidelines.

Insecta: Coleoptera (Terrestrial Beetles – Tiger, Leaf, Burying, and Scarab Beetles)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.
- Threats to the other terrestrial beetles are unknown, but may include light pollution (American burying beetle) and narrow host specificity (*Xyloryctes jamaicensis* and *Longitarsus subrufus*).

Habitat Alteration or Loss

Beetles occupy a variety of terrestrial habitats. These habitats are influenced or threatened by a variety of factors, including:

- succession of sand blows and barrens,
- foot or vehicular traffic on beaches and sand blows, and
- plantings or conversions from open vegetation types to plantations, agriculture, etc.

Tiger beetles require bare soil ranging from loose sand to packed clay. Partial to full exposure to sunlight also is required, although some species require openings in forested landscapes. Larvae cannot withstand excessive disturbance of the soil in which they burrow.

Priority Conservation Actions

- Conduct systematic species atlasing, status surveys, population monitoring, and basic life history research.
- Develop and apply general habitat management guidelines.

Insecta: Coleoptera (Aquatic Beetles - Water Scavenger, Predaceous Diving, Riffle, Whirlygig, Minute Moss, Burrowing Water, Crawling Water, Long-toed Water, Travertine, Water Penny, and Beaver Beetles and Weevils)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.

Habitat Alteration or Loss

Aquatic beetles considered Species of Greatest Conservation Need are taxonomically and ecologically diverse and occupy almost every conceivable aquatic or wetland habitat. Certain beetle habitats (e.g., spring seeps, spring runs, and spring ponds, forested ephemeral ponds, peatlands, warm headwater streams, medium to large fast flowing warmwater streams, as well as a variety of very specific microhabitats in aquatic settings) merit targeted conservation efforts. These habitats are influenced or threatened by a variety of factors, including:

- alterations to groundwater hydrology,
- impoundments and their associated impacts,
- nonpoint source pollution, particularly inorganic sedimentation,
- direct physical disturbance, and
- opening or alteration of forest canopies.

Priority Conservation Actions

- Conduct systematic species atlasing, status surveys, population monitoring, and basic life history research.
- Develop and apply general habitat management guidelines.
- Protect and manage specific waterbodies and watersheds containing significant populations of Species of Greatest Conservation Need.

Insecta: Plecoptera (Stoneflies)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.

Habitat Alteration or Loss

Stoneflies occupy a variety of aquatic habitats in their larval stages. These habitats are influenced or threatened by a variety of factors, including:

- alteration of flow regimes caused by impoundments and large scale conversion of natural cover types in the watershed,
- point and nonpoint sources of pollutants,
- shoreline and littoral zone modifications,
- potential global climate change impacts,
- drainage or impoundment of natural wetlands, and
- introduction of fish or management for fish in naturally fishless (shallow) waterbodies.

Priority Conservation Actions

- Conduct systematic species atlasing, status surveys, population monitoring, and basic life history research.
- Develop and apply general habitat management guidelines.
- Protection and management of specific waterbodies and watersheds containing significant populations of Species of Greatest Conservation Need.

Insecta: Trichoptera (Caddisflies)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.

Habitat Alteration or Loss

Caddisflies occupy a variety of aquatic habitats in their larval stages. These habitats are influenced or threatened by a variety of factors, including:

- alteration of flow regimes caused by impoundments and large scale conversion of natural cover types in the watershed,
- point and nonpoint sources of pollutants,
- shoreline and littoral zone modifications,
- potential global climate change impacts,
- drainage or impoundment of natural wetlands, and
- introduction of fish or management for fish in naturally fishless (shallow) waterbodies.

Priority Conservation Actions

- Conduct systematic species atlasing, status surveys, population monitoring, and basic life history research.
- Develop and apply general habitat management guidelines.
- Protection and management of specific waterbodies and watersheds containing significant populations of Species of Greatest Conservation Need.

Insecta: Lepidoptera (Butterflies and Moths)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of some species remain poorly known.
- We lack sufficient information on specific species or populations.

Biological Factors

- Small populations may be affected by inbreeding and genetic swamping.
- Small numbers of populations or extremely small or very localized extant populations limit genetic exchange and long-term population viability.
- The poor dispersal ability of some species or lack of dispersal from core populations may limit population viability and conservation opportunities.
- Potential mortality to some species due to over collecting.

Habitat Alteration or Loss

Many lepidopterans have specific food plant preferences. Given these requirements, habitat loss poses a threat to the ability of these animals to persist on the landscape. Threats include:

- complete loss or fragmentation of habitat due to development,
- disturbance due to human activities (recreation, transportation, land management, etc.),
- alteration of plant community structure through succession, prairie and forest management practices, and incursion of invasive plant species, and
- wetland modification.

Management Challenges

- Lack of communication with and/or involvement of site managers in lepidopteran conservation efforts.
- Lack of appropriate site management plans (including how to address any conflicting management guidelines recommended for different species).

- Unintended consequences of habitat management practices (e.g. lack of management, over management, intensity of management, timing of management, scale of management, etc.).
- Broadcast application of insecticides (e.g., Btk)

Priority Conservation Actions

- Continue systematic species atlasing and inventory efforts.
- Conduct population monitoring and life history research for those species that require additional information for successful conservation.
- Prepare and implement species recovery plans needed for all state-listed lepidopterans.
- Develop and implement site-specific management for highly localized populations.
- Augment populations or establish species at additional sites (e.g., at historic sites).
- Prepare and implement general habitat management guidelines (e.g., for grassland Species of Greatest Conservation Need).
- Maintain corridors connecting occupied sites to prevent isolating populations.
- Control and manage invasive species.
- Identify those species or populations where specific management actions are not required or appropriate.

Insecta: Diptera (Aquatic Flies)

Threats and Issues

Lack of Information

- Many aspects of the basic biology of the species remain poorly known.
- We have limited information on species distributions and populations.

Habitat Alteration or Loss

Flies occupy a variety of aquatic habitats in their larval stages. These habitats are influenced or threatened by a variety of factors, including:

- alteration of flow regimes caused by impoundments and large scale conversion of natural cover types in the watershed,
- point and nonpoint sources of pollutants.
- shoreline and littoral zone modifications,
- potential global climate change impacts,
- drainage or impoundment of natural wetlands, and
- introduction of fish or management for fish in naturally fishless (shallow) waterbodies.

Priority Conservation Actions

- Conduct systematic species atlasing, status surveys, population monitoring, and basic life history research.
- Develop and apply general habitat management guidelines.
- Protect and manage specific waterbodies and watersheds containing significant populations of Species of Greatest Conservation Need.